

AMD vs Nvidia: Market Analysis of Semiconductor Giants

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Game Theory

Introduction

This paper will attempt to analyze the GPU market, and predict the best response for AMD pricing strategy regarding their newly announced GPU lineup, the RX 6000 series, in order to stay competitive with Nvidia, and potentially grab hold of a larger market share.

Background

Advanced Micro Devices (AMD) is a semiconductor company that was founded in 1969. In 2006, AMD acquired ATI technologies, another semiconductor corporation which was leading in the production of Graphics Processing Units (GPU's) at the time of acquisition.

Nvidia, also a semiconductor corporation founded in 1993, was responsible for inventing the first dedicated GPU in 1999. Before this, Graphics Processing Units were integrated alongside the Central Processing Unit (CPU) and were not standalone hardware. When discussing GPU's in this paper, I will be referring exclusively to the dedicated hardware Graphic Processing Units.

For the better part of this century so far, AMD and Nvidia have been going head to head with each generation of their GPU lineups. AMD had overshadowed Nvidia in the latter part of the end of the 2010's, but Nvidia had overtaken AMD since about 2015 and on, in terms of raw GPU horsepower, and AMD's GPU sales were faltering.

AMD as a company nearly went completely under around the years of 2009-2015. The average stock price was less than \$2 per share, and AMD's sales of CPU's were being annihilated by Integrated Electronics (Intel) CPU's. In comparison, Intel's stock price that same time was around \$30. (Google Finance, n.d.)

In the last quarter of 2014, AMD appointed Lisa Su as their new Chief Executive Officer. Since becoming CEO, Su has been able to guide AMD's CPU division in the right direction. In 2017, AMD launched its first revamped line of CPU, the Ryzen 1000 series. Since the first generation of Ryzen processors, AMD has been able to overtake Intel in sales, for the first time in a decade. AMD's stock price as of late September, has been in the high \$70's-\$80's, while Intel averages around \$50. (Google Finance, n.d.)

However, AMD's GPU division has not been so lucky. They have managed to take back some of the market with their release of the 5700 series GPU's, but Nvidia still holds strong. AMD has been rumored to release a new GPU coined as the "Nvidia Killer" (Bardwell, 2020) sometime in the following months. The cooler shroud on their new RX 6000 series GPU's have been announced (Dexter, 2020), but there is no information as to the specifications or MSRP of these upcoming GPU's.

Nvidia also recently announced their new GPU lineup, the 3000 series cards. This is their 2nd generation of raytracing based (RTX) cards. Currently, they have announced the RTX 3070, RTX 3080, and RTX 3090. (NVIDIA, n.d.)

Analysis

Nvidia's first generation of RTX cards were notoriously seen to be overpriced by consumers. The RTX 2000 series cards were a nearly two-fold increase in price over their GTX ancestors. Nvidia has a track record of pricing each new GPU generation successor to the last, exponentially higher.

The launch MSRP in 2018 of the first generation RTX cards were as follows:

RTX 2070 - \$499 (\$599 Founders Edition)

RTX 2080 - \$699 (\$799 Founders Edition)

Titan RTX - \$2,499

(GEFORCE RTX, n.d.)

"Founders Edition" referring to the original, not AIB partner cooler design (the default look of the GPU before 3rd part partners modify it for better aesthetics/cooling performance). Nvidia's refresh and mid-range RTX cards (2070 Super, 2080 Super, 2080TI, & 2060) being released later the following year. The "Titan RTX" card is not meant to be purchased by everyday consumers (for gaming, simple office work, etc.) but rather it is a workstation "prosumer" card, hence the price tag.

Now, Nvidia's current 3000 series of cards set to release later this year, are priced as follows:

RTX 3070 - \$499

RTX 3080 - \$699

RTX 3090 - \$1,499

(GEFORCE RTX, n.d.)

Notice how the successors for the 2000's series cards are priced at the same MSRP, and not higher as the trend has been for the past several generations. Also, you may notice that there is a card titled as the RTX 3090" in place of the "Titan RTX". It is rumored that the Titan cards are now going to be referred to with the xx90 nomenclature. In this case, the new RTX 3090 replacement GPU is \$1,000 cheaper than its Titan predecessor. Nvidia is well aware of AMD's plans to release an "Nvidia Killer" GPU, and has likely used those rumors to aggressively price their newest 3000 series GPU lineup.

AMD, being successful with their RX 5000 series launch last year, needs to be careful with their MRSP approach to the RX 6000 series. Given that if Nvidia undercuts them in launch price, AMD will have a very hard time winning over consumers in the long run. (Dexter, 2020) Even if AMD were to match Nvidia in performance and price, Nvidia still has a longer track

record of stable drivers, and additional proprietary features that AMD GPU's do not have the benefit of having access to. (NVIDIA Developer, n.d.)

Despite AMD's best efforts with their previous gen refresh release of the RX 5000 series GPU's, the current market share of the GPU segment is still led by Nvidia.

“Nvidia claimed 80% of the discrete GPU market in the second quarter of 2020, stealing market share from rival AMD.

That's according to the latest figures from Jon Peddie Research (JPR), which claim that Nvidia saw its share of the graphics card market increase from 71% in the second quarter of 2019 to 80% in the Q2 2020.

That impressive growth has come at the expense of rival AMD, which saw its slice of the market shrink from 29% to 20% over the same 12-month period.” (Page, 2020)

AMD's 5000 series GPU's were still an impressive feat, with PCIE Gen 4 support and other chipset improvements over the former gen (Vega) series. The RX 5000 cards are also the first mainstream consumer GPU's to be on the 7nm process node, giving the generation a much better power-draw to performance ratio.

We already know that Nvidia's newest RTX 3000 series cards price point, being equal to or less than that of the RTX 2000 series cards while offering significant performance gains in Ray Tracing technology. To beat that, AMD would need to undercut Nvidia's MSRP by a significant enough margin, that consumers would fail to see the reason to purchase an Nvidia GPU if the AMD variant offers a price-to-performance steal. If AMD matches Nvidia's MRSP, they will need to seriously compete with their own Ray Tracing technology or offer features and functionality that Nvidia cards do not.

For example, Nvidia removed SLI support (a feature that allows for the use of more than one card in a single system, in parallel). This is still a very important feature in many software applications, especially legacy ones. If AMD continues to support Crossfire (Their SLI equivalent) buying their GPU cards instead would yield an additional benefit.

The new AMD RX 6000 series cards are already slated to support Ray Tracing, as Nvidia cards do (Moore-Colyer, 2020). The question will be whether or not the Ray Tracing performance will be competitive with what Nvidia's newer GPU's will provide, which we know is about 75%-100% faster than that of their first generation RTX 3000 series cards, which capped at 60fps in most games. (Cleveland, 2019)

Currently, AMD has only shown two new GPU's set to release this year. Rumored to be called the RC 6700 and the RX 6800. Since Nvidia's “prosumer” Titan card has been rebranded as a standard, extremely high-end “consumer” GPU, it is very unlikely than either of those two AMD cards would rival the performance of the RTX 3090. So let's assume that the AMD RX 3700 and RX 3800 will compete against Nvidia's RTX 3070 and RTX 3080 respectively.

AMD already knows Nvidia's MSRP prices for those two cards, at \$499/\$699 for the RTX 3070/RTX 3080. In a perfect world, if all GPU specifications are identical, and both cards have Ray Tracing technology, AMD can also price their RX 6700/RX 6800 at \$499/\$699 and possibly win an even split of the GPU market against Nvidia. If AMD prices their cards any higher than this, they are doomed to lose in this market unless Nvidia's 3000 series cards turn out to only be a "paper-launch", and there aren't enough GPU's in stock for consumer to purchase before the end of this year. In which case, AMD would be free to price their RX 6000 series cards higher.

But this will still be a risky move on AMD's part, and Nvidia has gathered a loyal consumer base over the years by being the leader of the GPU market. To sway users over to better ensure that even split in market share, AMD would need to price their GPU's instead at \$449 & \$649 for the RX 6700 & RX 6800 respectively. But we also have Nvidia's 3000 series specifications, which are as follows:

30xx GPU Series Name	VRAM	Power Draw
RTX 3070	8GB	220 Watts
RTX 3080	10GB	320 Watts
RTX 3090	24GB	350 Watts

(GEFORCE RTX 30 SERIES, n.d.)

These large power draws required Nvidia to create a new, proprietary 12pin connector for this generation of GPU's. For consumers, this means the Power Supply Unit (PSU) that they are using with their current system, will not be compatible with Nvidia's 3000 series cards. Purchasing a new PSU or PSU 8pin to 12pin adapter will incur additional costs. This is already working in favor for AMD's lineup, as their new GPU lineup will use two standard 8pin power connectors for their cards as seen in the image teasers they released. (Sebastian, 2020)

Preorders for Nvidia's RTX 3000 series cards already began on September 17th, and within mere minutes, the entire inventory on every retailer's site was sold out. (Dent, 2020) "Scalpers" had purchased these cards in vast numbers, to resell them on 3rd party sites such as eBay. Some of these GPU listings had then resold for as much as \$70,000. (Nelius, 2020) So in theory, the maximum MSRP AMD could set their new 6000 series GPU lineup would be capped at 70k, all else equal.

Nvidia has already begun to market their 3000 series GPUs, not only for 4K gaming, but even 8K gaming (which is 4x the resolution of 4K, and 16x the resolution of a standard, 16:9 1080p monitor). As you can see from the table above, the more "affordable" consumer cards have only 8GB and 10GB of VRAM. VRAM is critical when using applications and playing games at 4K and 8K resolutions. To play games at 4K resolutions, it would require a minimum of 128MB for each frame, plus any additional resources allocated to the VRAM, which is not limited to Textures, Models, Screen Space Reflections, Ray Tracing, etc. (Sebastian, 2020) This means that any consumer who purchases an RTX 3070 or RTX 3080, will find that the *G and

10GB of VRAM is inadequate at 4K/8K resolutions without significantly toning down other graphical settings of the application.

AMD however, is leaked to have their lineup of cards include 12GB and 16GB of VRAM, which means they will have a massive advantage over texture streaming at these resolutions over their Nvidia counterparts. (Mujtaba, 2020)

A final deciding factor between these two GOU rivals for consumers is thermals. Cooler design and heat dissipation plays a large role in how well the GPU can handle long periods of intense use. Early reviews of the RTX 3000 series cards already show that Nvidia's cooler design for these cards is not ideal for long and intensive use with the average computer chassis, as the opposing fan design blows hot air into the case, potentially affecting the performance and lifespan of other PC components. (JoshPJ, 2020) AMD's cards have dual axial or triple axial fans on one side, so the airflow would only be in one direction, making managing heat dissipation in any chassis easier to direct.

Conclusion

It's safe to assume that if AMD matches or slightly undercuts the MSRP prices of their RX 6000 series GPU lineup, they have a good chance of attaining a larger share of the GPU market without losing a significant margin of profit off those cards. If AMD suspects that Nvidia's RTX 3000 series lineup of cards is a paper launch, they can be more inclined to price their MSRP higher than that of Nvidia's MSRP, as the stock available of Nvidia's cards won't be enough to provide the majority of consumers with a GPU. AMD's best response in any case if these factors are not known, is to win over consumers by offering a lower official MSRP at \$449 and \$649 for their RX 6700 and RX 6800 GPU's respectively.

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